Introduction to Eastman Eastoflex™ Amorphous Polyolefins

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Types of Amorphous Polyolefins (APO)

- Propylene homopolymer
- Propylene-ethylene copolymer
- Propylene-butene copolymer
- Propylene-ethylene-butene terpolymer
- Propylene-hexene copolymer

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Product	Thermosel Viscosity @ 190°C, mPa•s	Ring & Ball Softening Point, °C	Glass Transition Temperature, °C	Penetration Hardness, dmm	Tensile Strength, MPa (psi)	Elongation, %
Propylene Homopolymers						
P1010PL	700-1250	148-158	–10	20	1.38 (200)	200
P1023PL	1550-2750	150-160	–10	20	1.38 (200)	100
Polypropylene/Propylene-Ethylene Copolymer Mixtures						
M1010PL	1000	150	–15	35	0.90 (130)	35
M1018PL	1800	150	–13	25	0.83 (120)	100
M1020PL	2000	145	–21	40	0.34 (50)	100
M1030PL	3000	150	–10	25	1.03 (150)	100
M1058PL	5800	151	–15	25	1.24 (180)	100
M2058PL	6000	151	-19	25		
Propylene-Ethylene Copolymers						
E1016PL	1600	130-140		60		
E1045PL	4500	135	–27	50	0.34 (50)	75
E1060PL	4500-7200	130-145	–23	40	0.34 (50)	100
E1200PL	14000-	130-145	–28	35	1.03	100

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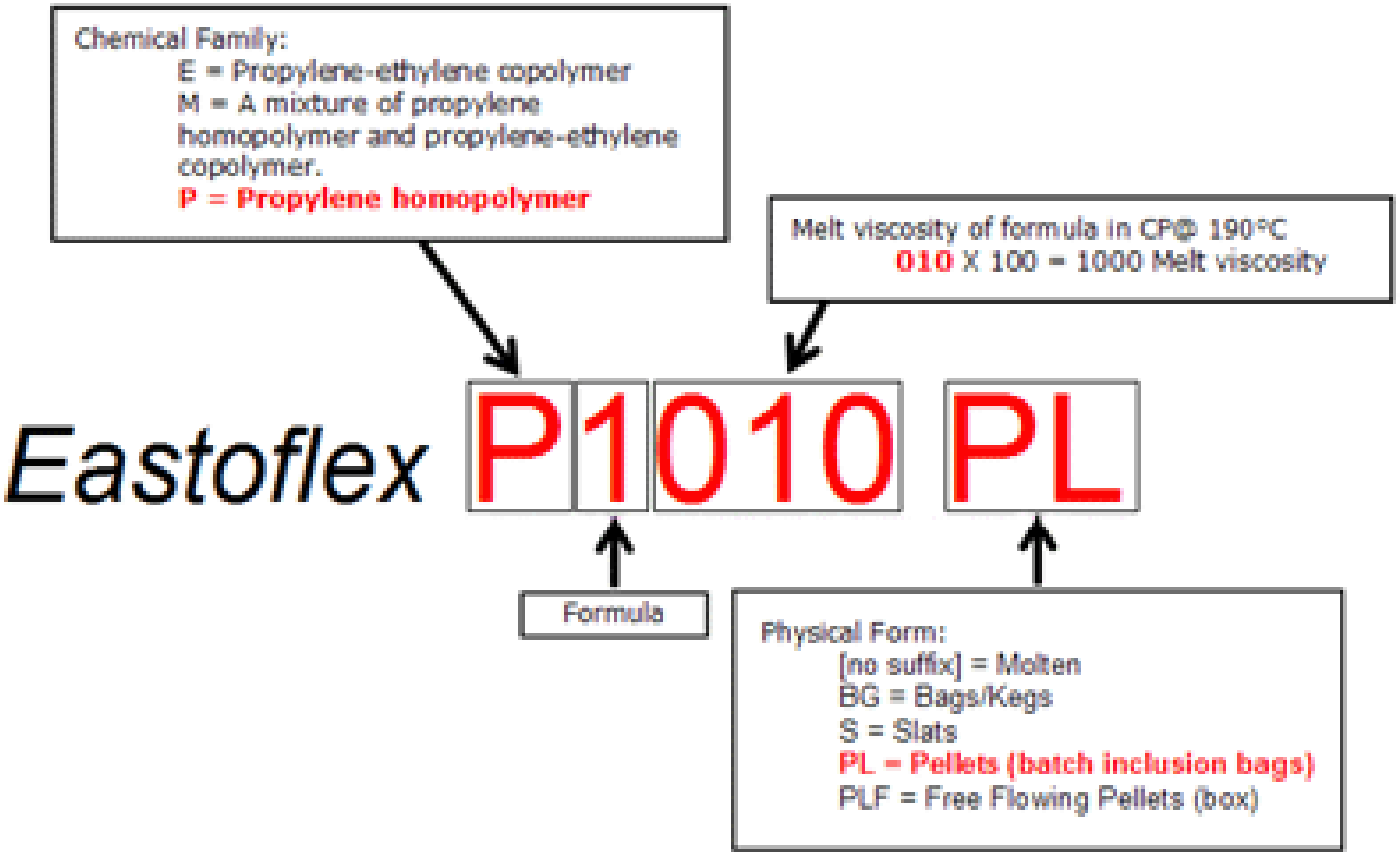
Identifying by Trademark Name



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Eastoflex™ APO- Useful Properties

- Made on-purpose in dedicated plants
  - Consistent quality through SPC
  - Low color
  - Good thermal stability
- Wide product range:
  - Softening points from 120°C
  - Needle penetration from 20 to 90 dmm
  - Melt viscosity from 300 to 20,000 cps
- Propylene homopolymers and propylene-ethylene copolymers
- Custom blending facilities
- Low density
- Excellent waterproofing properties

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Applications of Eastoflex™ APO

- Hot Melt Adhesives
  - Paper Laminating
  - Product Assembly
  - Packaging
  - Nonwoven construction
- Filled Formulations
  - Sealants
  - Carpet Backing
  - Sound Insulation
- Asphalt & Bitumen Modification
  - Roofing
  - Road Construction
- Polymer Modifications

Compatibility Profile of APO

- COMPATIBLE WITH
  - Isotactic polypropylene
  - Low density polyethylene
  - Butyl rubber
  - Natural rubber
  - Polybutylene rubber
  - S-I-S Block copolymer
  - S-EB-S Block copolymer
  - C-5 Tackifying resins
  - Polyterpene tackifiers
  - Polybutene
  - Mineral oil
- INCOMPATIBLE WITH
  - S-B-S Block copolymer
  - SBR rubber
  - EVA copolymers
  - C-9 Tackifiers
  - Rosin Tackifiers
  - Acrylics
  - Urethanes
  - Polyamides
  - Polyesters

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Polymer–Tackifier Compatibility

Polymer Type	Solubility Parameter	Tackifier Compatibility
PE / APO / PB / OBC / mPO sEBs & sIs (midblock ethylene butylene or isoprene)	Aliphatic, low polarity	Aliphatic Resins (low) Modified Aliphatic Resins Hydrogenated Rosin Resins
sBs (midblock butadiene)	Aliphatic, some polarity	(low) Modified Aliphatic Resins Rosin resins
EVA		Aliphatic Resins (low VA EVA only) (low to mid) Modified Aliphatic Resins Aromatic Resins (C9 & PMR) Rosin Resins
EBA / EEA / EMA	Aliphatic, high polarity	Rosin Resins Aromatic Resins (PMR)
SiS, SbS, SebS (endblock)	Aromatic, high polarity	Aromatic Resins (PMR)
Acrylic, Polyester, Urethane, Polyamide	High polarity, hydrogen bonding	(low) Modified Aromatic Resins (pH2 PMR) Aromatic Resins (C9 & PMR) Rosin Resins

Solubility & Color of Tackifying Resins

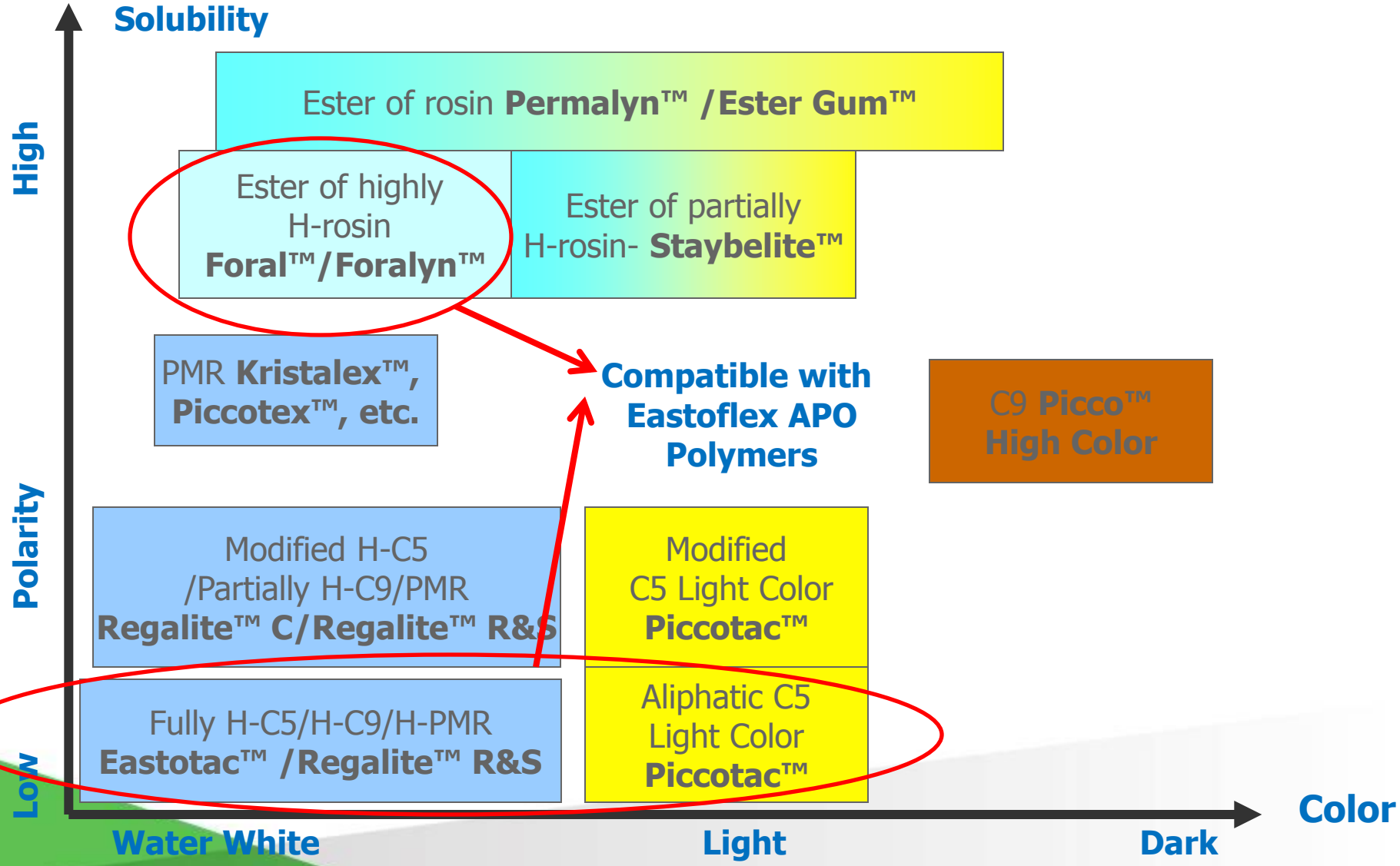

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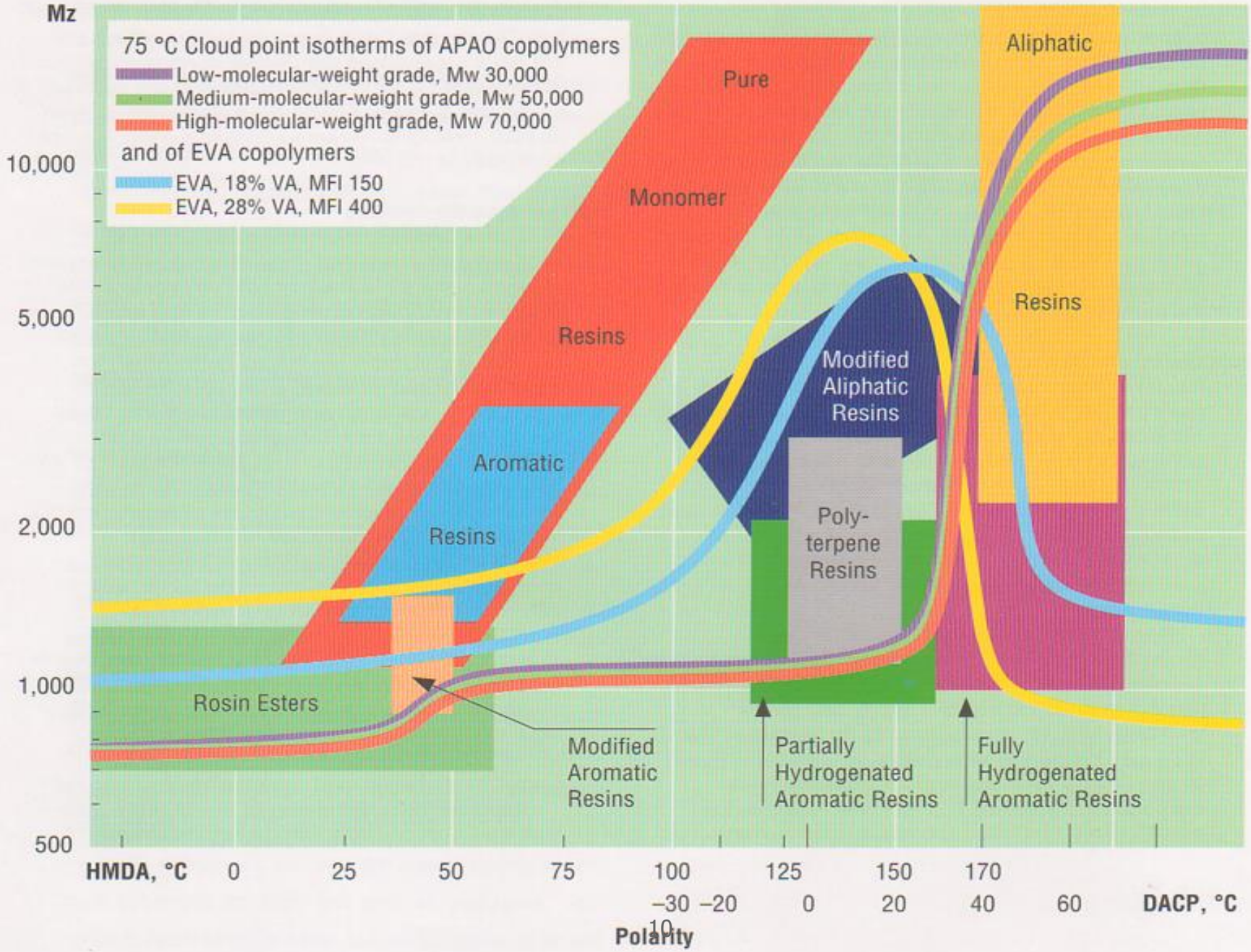
Figure 1 - Polarity versus molecular weight (M_Z) of resin families



Clarity of APO/Tacikifier Blends

Resin Type	Product	Clarity
Hydrogenated Aliphatic	Eastotac H & C	Excellent
Hydrogenated C9	Regalite R&S 1100	Excellent
Highly Hydrogenated resin glyceryl esters	Foral 85-E/Foralyn 90	Excellent
Aliphatic C5	Piccotac 1100, 1098, 1095 Resins	Excellent
H-DCPD		Average
Partially Hydrogenated glycerol ester	Staybelite Ester 10-E	Average
Modified C5	Piccotac 6095/7050	Poor
Partially hydrogenated pentaerythritol ester	Pentalyn H-E	Poor

Typical Formulations containing Eastoflex™ APO

INGREDIENTS	Packaging	Product Assembly
Eastoflex™ E1060 APE	15	29.7
Eastoflex™ P1023 APP	12	30.0
Eastotac™ H-130 Resin	30.0	35.0
Eastotac™ H-100 Resin	0	
Epolene™ N-21 Wax	3.0	5.0
Epolene™ C-15 Polymer	40.0	
Kraton™ G-1652		
Shelflex™ 371		
Antioxidants		

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General Purpose Application

		Units	C-115R
Eastoflex™ P1023	39.85%	grams	338.73
Eastoflex™ E1060	39.85%	grams	338.73
Eastotac ™C115R	20.00%	grams	170.00
Irganox™ 1010	0.30%	grams	2.55
Total		grams	850

Viscosity @ 177°C	mPa.s	3519
Gardner Color		3
RBSP, deg C	°C	145.8

100 hr Viscosity @ 177°C	mPa.s	2640
Viscosity Change	%	-25
100 hr Gardner Color		11
Gardner Color Change		8

Set Time, sec	sec	16
Open Time, sec	sec	179
Green Strength, sec	sec	2
PAFT, deg C	°C	36
SAFT, deg C	°C	73

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Eastoflex™ APO for HMA

- Base polymer blend
  - E1060 starting material, modified with P types to give better strength
  - Eastoflex Polymers /PE wax Blends
- APO based HMA
  - Excellent thermal stability
  - Excellent heat resistance
- Partial Replacement of SIS and SEBS
  - Better Heat Stability
  - Lower Cost
  - Compromise of cohesive strength

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